FINAL REPORT
Specialty Crop Block Grant FB-09

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Assessment of "Narrow Row Technology" for the
Michigan Dry Bean Industry

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Specialty Crop Block Grant FB-09 Final Report
Michigan Bean Commission
Title: Assessment of "Narrow Row Technology" for the Michigan Dry Bean Industry

Outline and Need for Project

This project is needed to assess the potential for adoption and use of 'narrow row technology' by Michigan dry bean growers. This innovative cropping system is essential for growers to be competitive with other crops such as soybeans and corn and enhance the commercial viability and sustainability of this important sector of Michigan's diverse agricultural base. 'Narrow row technology provides numerous economic and agronomic advantages for production of dry beans.

The traditional dry bean cropping system is contrasted with 'narrow row technology in the following means: 1. Traditional cropping requires many more field passes to achieve proper tillage while 'narrow row technology' employs fewer operations from planting to harvest. 2. Traditional harvesting requires multiple field passes to first pull and window plants for field drying followed by a subsequent pass with a combine for thrashing. This procedure exposes beans to inclement weather and increased levels of stones which are raised when the plants are uprooted. 3. Direct harvesting requires the use of plant desiccants to defoliate the plant prior to harvest to enable seed and plant dry down. Most of the desiccants have limitations for use in dry beans and new desiccants must be found to eliminate rotation restrictions, residue contamination and extremely high toxicity problems. 4. Traditional cropping allows dry beans to be lodged and close to the ground. There is a need to develop dry bean varieties to stand erect with elevated pods to aid in direct harvesting operations.

Project Approach

To assure validity of the results and subsequent recommendations, a plan of work included: 1. Research Farm plot trials, 2. Grower-based strip trials, 3. Fungicide trials to control white mold, 4. Canning trials conducted on dry bean varieties grown in grower-based strip trials and dry bean nurseries of elite dry bean lines, 5. University based research on new dry bean varieties and 6. University based research on new desiccants and herbicides in commercial dry bean production systems.

Greg Varner conducted small plot trials at the research farm comparing 15, 20 and 30 inch rows on navy, black and small red beans. Small plot trials were also conducted on black and small red bean populations. He also conducted five grower strip trials in the major dry bean counties of Michigan. The white mold fungicide trial was conducted at the Montcalm Research farm where adequate irrigation provides excellent white mold disease expression. Canning trials were conducted at the Michigan State University Food Science Pilot Canning Plant on campus.

Dr Christy Sprague conducted desiccant and herbicide trials at the research farm and herbicide trial at the main campus of Michigan State University. Dr. James Kelly conducted dry bean variety trials at the research farm.

Progress on Expected Outcomes

The following are specific outcomes providing direct benefit to Michigan Dry Bean Growers:

Identification of navy bean lines N09175 and N08003 and black bean line B09174 with excellent architecture and yield for narrow row direct harvest dry bean production.

Identification of a new desiccant product Sharpen (saflufenacil) from BASF potentially offering Michigan dry bean producers a more effective, potentially safer dry bean desiccation option.

Identification of a new fungicide Propulse from Bayer Crop Science potentially offering dry bean growers another fungicide alternative for white mold control.

Plant populations at 100,000 in narrow rows at the grower level achieved excellent yields. Sprague's research confirmed a plant population of 106,000 achieved maximum yields.

Identification of poor canning quality in certain navy and pinto varieties grown in Michigan.

Dissemination of Results and Additional Information

Presentation of results to Michigan growers and agri-business representatives:
1) Saginaw Valley Research and Extension Center Field Day. August 24, 2010. Richville, MI.
Showed 180 growers the five small field trials showing varying row widths and plant populations.
2) Bay, Gratiot, Huron, Montcalm, Sanilac and Tuscola County Dry Bean Tours. August 18-September 1 2010. Showed 240 dry bean growers commercial and experimental dry bean cultivars planted in 20 inch rows.
3) Michigan Dry Bean Variety Trials and Canning Trials and First Year Dry Bean Narrow Row Research Report posted online at www.maes.msu.edu/ressta/saginawvalley/. The Research Report is also posted on the Michigan Bean Commission website at www.michiganbean.org.
4) Published and distributed 1000 copies of the First Year Dry Bean Narrow Row Research Report. These reports will be handed out at dry bean elevators and at the 2011 County Dry Bean Meetings.
5) PowerPoint Presentation on Narrow Row Grower Strip Trials and Small Plot Trials at 2011 County Dry Bean Meetings.

6) State Dry Bean Day in February, 2011. Dissemination of Narrow Row Research Reports and Grower Panel on Narrow Row Production Practices.
7) Michigan Dry Bean Commission Newsletter. Approximately 2200 circulation. November 5, 2010. Results of the two navy bean strip trials. January 3, 2011. Results of the two black bean strip trials.
8) YouTube, Harvesting the "Stoutenburg black bean grower strip trial" http://www.youtube.com/watch?v=lhd9zlp_Cl, Title:2010 Drybean Plot Harvest @Stoutenburg Farms

Budget Information – See Appendix A

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The Research Report- See Appendix B

Field Plot Trials

Title: Row Width and Plant Populations in Dry Beans
Principal Investigator: Gregory Varner, Research Director, Michigan Dry Edible Bean Research Advisory Board. Michigan Bean Commission, 1031 S. U.S. 27, St. Johns, MI 48879
Field research trials were conducted at the Saginaw Valley Research and Extension Center north of Frankenmuth, Michigan. The five trials examined the effect of varying row widths and dry bean populations on: 1) plant height, 2) lodging, and 3) yield. Three dry bean classes and individual varieties were Medalist and Vista navy beans, Shania and Zorro black beans and Merlot small red beans. Three row widths used were 15, 20 and 30 inch spacing. Planting populations used in the Merlot small red trial were 125,000, 115,000 and 100,000. The Zorro black bean planting populations were 150,000, 140,000, 130,000, 120,000 and 110,000.
The Saginaw Valley trial location received 35% of normal rainfall from planting to harvest. The severe drought reduced dry bean yields 50% or higher when compared to 2009.
The Merlot small red row width trial showed no significant difference in yields between the three row widths. The 30 inch row width spacing showed the tallest height followed by the 20 inch spacing over the 15 inch rows. Lodging was constant with all the row widths.
Vista and Medalist navy beans planted in 30 inch rows were taller than the 20 and 15 inch rows. Vista yielded higher than Medalist in the 15 inch row spacing; however there was no difference in yield at the 20 and 30 inch spacing.

Shania and Zorro black beans planted in 30 inch rows were taller than the 20 and 15 inch rows. Across all three trials, the 30 inch rows had the tallest plant height. Plant to plant competition within the row is more aggressive in the 30 inch rows. There was no significant difference in yield between the 15 and 30 inch rows. The 20 inch row spacing yielded the least and Shania yielded significantly lower in the 20 inch row spacing when

compared to both the 15 and 30 inch row spacing. Zorro yield significantly less in the 20 inch rows when compared to 15 inch rows.
Zorro black beans planted in five populations showed no yield increase between the 15 inch and 20 inch row spacing. Average plant height was highest in the 20 inch rows. Plant population counts revealed seed mortality and emergence loss of 20%. It would be expected to lose 10 -15 % from the planting population to the harvest population.
Merlot small red beans planted in 15 inch rows yielded higher than 20 inch rows. This yield variation was not significantly different. Plant height was very similar in both the 15 and 20 inch rows.

Evaluation of fungicide treatments to control white mold disease in dry beans was conducted at the Montcalm Research Farm in Entrican, Michigan. Merlot small red beans were planted on June 22 with 20 inch row spacing. During pod set to pod fill (reproductive stage); the trials had two weekly supplemental (.5 inch) irrigations to promote sclerotia germination and white mold infection on the bean plants. Fungicides were applied at 100% bloom (100% of the bean plants have at least one open flower). Some treatments were sprayed the second time, 7 days after the fist spray. Fungicides used in the trial were Topsin M, Omega, Endura, Proline, Propulse, Headline and a combination of Topsin M and Endura. Endura, Omega, Propulse Topsin M and the combination of Endura and Topsin M treatments provided good control and yielded significantly higher than the untreated beans. Proline did yield significant higher with two sprays. The Headline treatments showed lower disease infection, but yielded lower than the untreated beans. This would support past research data on Headline showing no efficacy on white mold disease.

Grower Strip Trials

Two navy bean strip trials were grown at the Voelker farm in Pigeon and the Lakke-Ewald farm in Unionville. The Voelker navy bean strip trial ranged in yields of 26.0-34.7 cwt per acre. Medalist navy had the highest yield in this trial. The Lakke-Ewald trial ranged between 26.4-30.8 cwt per acre. Medalist was also the highest yield in the Lakke-Ewald navy bean strip trial. Vista navy was the second highest in both strip trials. Plant populations varied between the navy varieties in both locations. This variation difference was likely caused by seed size differences. Smaller seed size generally will plant thicker because of more doubles being planted from the seed plate. The early (June 1) Voelker trial suffered more seed mortality than the later (June 15) trial. Medalist had the lowest seed population in both trials at 98,271 and 98,794. This would suggest navy populations of 100,000 are adequate to achieve maximum yields. There may be different optimum populations for each variety tested. New variety releases should be tested at different populations. The early Volker trial had less lodging than the Lakke-Ewald trial.
The Stoutenburg black bean strip trial in Sandusky ranged in yields of 24.3-28.9 cwt per acre. Black Velvet had the highest yield. The Schindler black bean trial in Auburn ranged between 20.5-26.5 cwt per acre. Zorro had the highest yield with 92,418 plants per acre. This Schindler trial received 2.5 inches of rain 6 days after planting. We had a higher percent of emergence losses in this trial than the Stoutenburg Trial. These two trials varied in planting population of 145,000 versus 125,000. Most dry beans have the ability to produce more pods per plant and compensate for a lower plant population. The overall

plant height was taller in the Schindler trial. This was probably due to the later date of planting (June 21 vs. June 10).

The Schindler pinto bean strip trial in Auburn ranged in yield of 18.8 and 22.6 cwt per acre. This trial received 2.5 inches of rain on June 27 slowing down overall growth in this trial. Buster pinto had the highest yield. The popular La Paz variety from North Dakota had the tallest height and Buster was the shortest. ADM 06203 was very erect, but had the lowest yield.

Dry bean samples from the five grower strip trials were processed at the Michigan State University Food Science Pilot Canning Plant. Canned product was opened and evaluated. One navy and two pinto bean cultivars showed poor canning quality. Canning quality ratings used a 1-7 scale with 7 being perfect appearance and 2 and 1 being poor appearance.

A strip trial was also planned to evaluate a biological control agent, Coniothyrium minitans (Contans) that shows promise in managing white mold in various crops. Contans was applied on the Bernia farm in Akron at planting and the field was heavily damaged by excessive rainfall. Fungicide sprays were planned for late July, but the trial site was abandoned due to severe stand losses.

2010 Grower Strip Trial Canning Evaluation

	Volker	**Ewald**
VISTA	**2.8**	**2.8**
MEDALIST	**4.2**	**4**
T9905	**3.1**	**3**
COOP 03019	**3.2**	**2.9**
COOP 02084	**4.1**	**3.6**
COOP 02098	**2.1**	**2**
COOP 99039-3	**3.1**	
INDI	**4.4**	

	Stoutenburg	Schindler
ZORRO	**3.9**	**4.6**
SHANIA	**3.5**	**3.7**
LORETO	**3.3**	**4.2**
BLACK VELVET	**3.6**	**3.2**
JAGUAR	**3.6**	

	Schindler
LA PAZ	**2.2**
LARIAT	**3.4**
BUSTER	**3.6**
ADM 06203	**1.7**

7=Excellent
5-6=Above Average
3-4=Average
2=Poor
1=Unacceptable

Title: "Evaluation of dry bean promising breeding lines and elite genetic material suitability for 'narrow row' production systems". Development and Maintenance of High-Yielding, Disease Resistant, Processor Quality Dry Bean Varieties suitable for Direct Harvest in Michigan

Principal Investigator: James D. Kelly and Evan Wright, Crop and Soil Sciences, Michigan State University, East Lansing MI 48824 kellyj@msu.edu
Cooperators: Greg Varner, Production Research Advisory Board, varnerbean@hotmail.com
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Objectives: Improve yield, architecture, disease resistance, stress tolerance and canning quality traits of the major commercial dry bean market classes important in Michigan.

Activities, Accomplishments, Impacts: A total of 2994 plots were harvested for yield in 2010 and over 2600 single plant selections were made in the early generation nurseries. Yield trials included 36-entry standard navy test; 64-entry standard black test; 16-entry preliminary black test; 56-entry prelim navy and black test: 36-entry standard GN and 64-entry standard pinto tests; 12-entry standard Tebo test; 16-entry GN PYT test; red/pink test with 30 entries; 42-entry Co-op and regional test that includes pinto, GN, red and pinks; bush cranberry test with 25 entries; kidney test with 42 entries; three

white mold tests: one with 64-entries and two 96-entry pinto trials; one 36-entry certified organic trial in Tuscola county; one potato leaf hopper (PLH) trial with 80-entries on campus; two canning quality trials for CONAGRA: 8-entry navy and 14-entry pinto and 400 single row plots as part of the BeanCAP project. All trials except for kidney, cranberry and white mold were direct harvested using new plot combine. Plots in Frankenmuth suffered from severe drought (3.25 inches rain from planting to harvest) that resulted in lower yields (average yield reduction exceeded 50% across nurseries compared to 2009) and some entries remained green and never matured. Plots at Montcalm had adequate rainfall and severe white mold infection developed under supplemental irrigation. As a result the program was able to identify sources of drought resistance in black, navy, pinto, red and great northern market classes and modest levels of white mold tolerance in cranberry and kidney bean trials.

Progress in black bean breeding: Zorro performed very well in statewide trials ranging from 21 to 33 cwt/a with an average yield of 27.6 cwt. Shania was next highest black bean at 26.4 cwt/a. Zorro yielded 18.2 cwt under drought in Frankenmuth followed by Loreta at 17.6 cwt and Shania at 16.8 cwt/a compared to test mean for the test of 15.7cwt for 64 entries. Only two lines outperformed Zorro in the test suggesting that it has good levels of drought tolerance. Zorro exhibited the highest level of resistance to root rots at a test site in Geneva NY. A number of new black beans lines with resistance to CBB and anthracnose continue to show promise and one line are under increase in the MDA greenhouse. CBB and anthracnose resistance is currently being integrated into the Zorro genetic background.

Progress in navy bean breeding: The order among navy bean varieties changed in 2010 due to drought. A new line from Canada OAC7-2 (17.4cwt) was the best among the named entries followed by Vista (15.2cwt) and T9905 (14.8cwt) with a trial mean 14.3cwt/a. Long season varieties like Medalist produced 11.5 cwt/a and Lighting dropped to 9 cwt/a suggesting that there is a dramatic difference in drought tolerance among navy bean varieties. Seed quality (fish mouth) problems were common in navy beans. The program has identified a group of lines that have high levels of resistance to CBB and anthracnose but canning quality and agronomic traits of these lines needs to be further evaluated before a final decision on release can be made.

Progress in pinto bean breeding: La Paz was the highest yielding pinto variety with yield ranging from 16.8 to 21.8 cwt. P07863 pinto was the next highest yielding entry for the fourth year in the MSU trials and topped all entries in statewide trials at 38 cwt under irrigation in Montcalm. It has outstanding yield potential, full season, very erect, stays green late but goes to harvest maturity in 7 days. It is a clear candidate as a direct harvest high yielding pinto to compete against other market classes and was tested extensively in statewide trials to determine if it meets all those criteria for yield and direct harvest in a pinto seed type. Drought severely reduced the yields of Lariat, Stampede and Santa Fe varieties and many western pinto varieties did not mature in 2010.

Progress in GN/Tebo bean breeding: The drought dramatically reduced yield of Fuji tebo bean to under 5 cwt in 2010 as plants remained green due to continued pod drop. Seed quality problems (fish mouth due to incomplete seed coats) were very common in GN lines including Matterhorn. One anthracnose resistance line G09303 that outyielded

Matterhorn did not display this problem and will tested further. Seed quality is a major selection criterion in this class.

Progress in small red/pink bean breeding: Merlot was the best small red variety in statewide and MSU trials. It yielded 17.7 cwt followed by Sedona pink at 16.5 cwt/a under drought. Two new lines from ND were tested but drought severely impacted their yield. A number of new red lines show potential but seed color and quality is not as good as Merlot. In general pink/red beans showed better tolerance to drought than other seed types.

Progress in kidney/cranberry bean breeding: The program continues the evaluation of K06619 and K06604 LRK lines that topped yield trials 2 out last 4 years. K06619 is an attractive bean, and ranked behind Chinook 2000 which had an excellent season in 2010. DRK lines, K08222 and K08228 were evaluated in statewide trials in 2010 and were competitive in yield. These lines were more competitive in absence of irrigation. White kidney K08961 topped the yield trial (36.8cwt) for second year and outperformed Beluga for the third year and matured 4-days earlier. An early maturing selection of Beluga was 5d earlier and yielded 3cwt more. Canning quality of all these lines needs to be confirmed before they are advanced for further testing. In cranberries Bellagio was competitive against Chianti (+1.5cwt) in statewide trials. White mold was severe in trials at Montcalm but the same lines that showed resistance in the past continued to show promise in 2010.

Matching Funds: Royalty funds from current MSU varieties; MAES funds partially support technician salary and provide field, greenhouse and lab facilities and equipment; Continue to collaborate with PRAB to conduct statewide testing of elite MSU breeding lines with funding from MDA; Funds from the National Sclerotinia Initiative for research on white mold, USDA-NIFA for research on PLH, BeanCAP applied genomics project, NIFA for drought studies, and Pulse CRSP project for work on drought and root rot in large-seeded beans.

Publications: Kelly, J.D., G.V. Varner, and B. Long. 2010. Registration of 'Santa Fe' pinto bean. J. Plant Registrations 4:12-16; Kelly, J.D., G.V. Varner, and E.M. Wright. 2010. Registration of 'Bellagio' cranberry bean. J. Plant Registrations 4: 171-174; Kwapata, K., R. Sabzikar, M.B. Sticklen, and J.D. Kelly. 2010. In vitro regeneration and morphogenesis studies in common bean. Plant Cell Tiss. Organ. Cult.: J. Plant Biotechnology. 100:97-105; Pastor-Corrales, M.A., E.M. Wright, S.G. Markel, H.E. Awale, J. D. Kelly, J.G. Jordahl, R.S. Lamppa, F.M. Mathew, J.M. Osorno, and R.S. Goswami. 2010. Comparing the virulence of new races of the common bean rust pathogen from Michigan and North Dakota. Annu. Rep Bean Improv. Coop. 53: 128-129.

EXPERIMENT 0101 STANDARD NAVY YIELD TRIAL **PLANTING DATE 06/10/10**

Dr. James D. Kelly and Evan Wright, Crops and Soil Sciences, Michigan State University

ENTRY	NAMES	YIELD CWT /ACRE	100 SEED WT.	DAYS TO FLOWER	DAYS TO MATURITY	LODGING	HEIGHT	D SC
N09175	N05311/B05055	19.4	21.9	41.0	89.1	1.0	50.3	
N09174	N05311/B05055	18.2	22.3	41.0	88.4	1.0	50.6	
N08003	N00844/N02237	17.9	20.9	39.0	88.2	1.0	49.2	
I10103	**OAC 7-2** (CDBN)	17.4	20.8	37.0	89.9	1.5	47.0	
N09021	N05319/B04316	17.3	19.8	37.5	87.3	1.0	48.3	
N09045	N05311/B05034	16.8	20.1	40.0	88.1	1.0	47.5	
N08004	N00844/N02237	16.7	18.7	39.5	86.6	1.0	47.5	
N05324	N00838/N00809//N00792	16.6	20.8	38.5	88.3	1.0	49.8	
N09020	N05319/B04316	16.3	19.3	39.0	87.2	1.0	47.7	
I10101	**COOP 02084**	16.2	22.2	38.0	87.8	1.0	49.2	
N09046	B04554/N05357	16.1	18.8	40.5	90.2	1.5	50.5	
N09054	N04152/N05346	15.3	20.4	37.5	87.0	1.0	48.9	
I92002	C-20*6/CN49-242, **VISTA**	15.2	20.6	38.0	90.5	2.0	50.5	
I08902	**HYLAND T9905**	14.8	22.2	37.0	89.8	1.0	49.0	
N08007	N01792/N03614	14.6	18.3	41.5	87.1	1.0	48.2	
N09104	N05311/B05055	14.5	19.4	41.5	87.2	1.0	48.3	
N09050	N04154/N00833	14.2	18.1	40.5	86.6	1.0	45.6	
N06702	N00809//B95556*2/I93154	14.0	19.3	40.5	86.3	1.0	47.2	
N07007	N03614/N00844	13.9	17.3	38.0	86.8	1.0	46.7	
N08002	N00844/N02237	13.9	19.7	38.0	88.3	1.0	47.8	
I06271	ND012103,**AVALANCHE**	13.7	20.6	38.5	90.2	2.0	48.9	
N07009	N03614/N00844	13.6	21.5	39.5	88.0	1.0	50.0	
N09044	N05311/X06121	13.5	18.3	41.5	89.2	1.0	47.9	
N09056	N04152/N05346	13.3	19.9	40.0	88.1	1.0	47.7	
N09055	N04152/N05346	12.9	18.3	39.5	87.0	1.0	47.4	
N09059	N04141/N05317	12.9	19.3	40.0	89.2	1.0	49.7	
N09038	B04316/B00101	12.8	21.2	35.5	87.8	2.0	48.6	
N09041	B05070/B05044	12.4	20.5	38.5	87.9	2.0	48.7	
N09053	N04154/I04101	12.2	20.3	41.5	87.3	1.0	45.8	
N09034	B05055/B05070	12.0	20.8	37.0	87.2	1.0	48.7	
N09035	B05055/B05070	11.5	19.9	38.5	88.3	1.5	48.4	
I08958	**MEDALIST**	11.5	20.0	38.5	91.2	2.0	50.7	
N09039	B05070/B05040	11.4	20.4	36.5	87.9	1.0	47.9	
N09106	N04109/B05055	10.6	17.3	36.0	86.5	1.0	44.5	
N09037	B04316/B00101	10.5	20.2	38.5	86.6	1.0	47.9	
I08903	**LIGHTNING**	9.0	18.8	38.5	92.6	1.5	49.7	
AVERAGE OF36 MEANS		14.3	20.0	38.9	88.2	1.2	48.4	
LSD (P=.05)		2.5	1.2	1.4	0.9	0.2	0.9	
COEFFICIENT OF VARIATION		12.2	4.3	2.5	0.8	11.2	1.4	

EXPERIMENT 0102 STANDARD BLACK YIELD TRIAL				DATE 06/10/10				
ENTRY	NAMES	YIELD CWT /ACRE	100 SEED WT.	DAYS TO FLOWER	DAYS TO MATURITY	LODGING	HEIGHT	I SC
B09174	N05311/B05055	19.2	25.7	42.5	88.0	1.0	49.0	
B09128	B05055/B05044	18.3	19.0	40.0	86.8	1.0	48.3	
B04554	ZORRO	18.2	19.1	41.0	88.9	1.0	48.4	
B09208	B04644/B04588	17.8	21.0	41.0	86.5	1.0	46.0	
B09135	B04316/B05040	17.7	20.6	41.0	88.8	1.0	49.8	
B09175	N05311/B05055	17.6	25.1	39.5	87.7	1.0	48.1	
I10102	LORETO	17.6	22.2	40.0	89.2	1.0	48.7	
B09188	B05054/B04588	17.2	22.9	42.0	89.9	1.0	49.1	
B09166	B04554/B04587	17.2	20.9	41.5	87.3	1.0	47.2	
B09200	B04444/B05044	17.2	17.7	40.0	88.1	1.0	49.6	
B09129	B05055/B04587	17.1	20.0	42.0	86.8	1.0	47.7	
I81066	SEL-BTS,T39	17.1	20.6	42.0	88.6	2.0	48.7	
B09202	B04444/B04588	17.0	19.6	40.5	87.1	1.0	46.7	
I03390	ND9902621-2, ECLIPSE	17.0	20.2	38.5	86.2	1.0	47.5	
B09194	B05055/B05044	16.9	18.1	42.5	88.5	1.0	47.5	
B09196	B05055/B04588	16.8	21.2	39.0	89.1	1.0	46.5	
B09138	B05054/B04588	16.8	23.1	41.0	87.9	1.0	47.4	
I07116	B201240, SHANIA	16.8	20.6	41.0	90.0	1.0	49.1	
B08102	B01792/B02549	16.8	21.2	41.5	87.0	1.0	46.1	
B09184	B04349/B05001	16.8	17.9	38.0	89.3	1.0	47.4	
B09198	B05055/B04587	16.6	19.6	39.5	88.0	1.0	48.4	
B09165	B04554/B04587	16.5	20.2	40.5	86.6	1.0	48.1	
B09170	B04554/B04587	16.5	19.3	42.0	88.9	1.0	46.9	
B09136	B04316/B05040	16.3	21.8	39.0	87.5	1.0	47.3	
B09224	B05054/B04588	16.3	23.2	40.5	87.0	1.0	46.9	
I08907	BLACK VELVET	16.3	24.8	41.5	91.0	1.0	49.0	
B09183	B04349/B05001	16.2	17.4	38.5	87.3	1.0	47.4	
B09210	B04644/B04588	16.1	20.7	41.0	86.6	1.0	45.7	
B09203	B05054/B04588	16.1	21.8	40.5	86.1	1.0	45.6	
B09164	B04554/B04587	16.0	19.4	42.0	87.0	1.0	48.5	
B09104	N05311/B05055	16.0	20.6	40.0	86.5	1.0	47.1	
B05055	1308//HR45/KABOON	16.0	20.6	41.0	87.4	1.0	45.9	
B09209	B04644/B04588	15.9	21.9	39.0	86.9	1.0	47.3	
B09199	B05055/B04587	15.9	22.3	41.5	87.3	1.0	46.2	
B09119	B04554/X06127	15.9	19.6	42.0	86.1	1.0	47.1	
B09120	B04554/X06127	15.8	19.7	40.5	87.0	1.0	47.1	
B09171	B04554/B04587	15.4	19.2	41.5	87.0	1.0	47.0	
B95556	B90211/N90616,JAGUAR	15.4	19.0	42.0	86.0	1.0	46.0	
B09130	B05055/B04587	15.4	19.3	39.0	85.9	1.0	45.9	
B09201	B04444/B05044	15.3	17.2	42.0	89.4	1.5	49.4	
B00101	CONDOR	15.2	20.8	39.5	89.0	1.5	48.5	
AVERAGE OF 64 MEANS		15.7	20.4	40.7	87.6	1.0	47.0	

LSD (P=.05)	2.9	1.1	1.1	0.8	0.1	0.8
COEFFICIENT OF VARIATION	12.8	3.8	1.9	0.7	6.8	1.1

PROGRESS REPORT

Project Title: "Evaluation of selected treatments (herbicides and plant desiccants) to enhance dry bean 'narrow row' efficiency and productivity". Optimizing row width and plant populations to improve weed management and yield in Michigan dry bean production systems.

Team leader: Christy L. Sprague, Associate Professor, Department of Crop and Soil Sciences

Accomplishments:

Previous research in other crops has indicated that narrow rows often suppress weeds, and several studies have also suggested that narrow rows may also improve yield. In order to determine the benefits and limitations of growing dry beans in narrow rows in Michigan, two field research studies were conducted in 2010 at two locations, the Saginaw Valley Research and Extension Center near Richville and the MSU Agronomy farm in East Lansing. The first studied examined the effect of varying row widths and bean populations on: 1) weed suppression, 2) plant architecture, 3) white mold development, 4) western bean cutworm egg laying and survival, and 5) yield in two classes of dry edible beans. The two dry bean classes examined were 'Zorro' black beans and 'Merlot' small red beans. Three row widths were examined at one location: 1) 15 inch, 2) 20 inch, and 3) 30 inch rows, while at the other location only 15 and 30 inch rows were examined. The three populations examined for black beans were 1) 79,500 plants per acre, 2) 106,000 plants per acre, and 3) 132,500 plants per acre. For small red beans, the populations were 1) 60,000 plants per acre, 2) 79,500 plants per acre, and 3) 106,000 plants per acre. Dry bean yield results varied between the two locations. The Saginaw Valley location suffered from drought, resulting in average yields of 15 hundred weight per acre for both black and small red beans. Under weed-free conditions black bean population did not have a significant affect yield, however row width had a major impact. The main effect of row width indicated that black bean planted in wide rows (30 inches) benefited under drought conditions compared with black bean planted in 15 inch rows. However, yield of black bean planted in 20 inch rows were not different from black bean planted in 30 or 15 inch rows. At East Lansing when moisture was not as limiting yield was favored for dry bean planted in narrow rows. Average black bean yield for this trial were 27 hundred weight per acre. The main effect of row width showed a 4.2 hundred weight advantage for black beans planted in 15 inch rows over black beans planted in 30 inch rows. The row width by population interaction was significant at (P = 0.0916), favoring black bean planted in narrow rows at the mid-population. For small red beans at East Lansing, regardless of row width or bean population the average yield was 22 hundred weight per acre. Indicating the 'Merlot' small red beans may have the ability to compensate for space regardless of population or row width. White mold did not develop in any of these trials and there did not appear to be a row width or population effect on the low level of western bean cutworm that was found in these trials. At East

Lansing, one thing we observed was the ability of narrower row widths to suppress weed growth in our POST only treatments in these trials (Figure 1). We also observed that the small red beans significantly reduced weed growth compared with the black beans. Lower weed populations at Richville did not show any differences in weed suppression.

The second study examined the effect of six different weed management strategies in dry beans planted in wide and narrow rows on 1) weed suppression and 2) yield. The cultivar planted in this study was 'Zorro' black bean at a consistent population of 106,000 plants per acre in both 15 and 30 inch rows. The narrow row width consistently reduced overall weed populations at one location, and at the other it reduced them in the herbicide treatments that exhibited poor control. Control of several weeds was better in the narrow row plots than in the wide row plots within certain weed control strategies. Narrow rows provided slightly higher yields at one location (P=0.1), although it appeared that there was not a good relationship between row width and herbicide treatment at the other location. At one location with high weed pressure, the total POST treatment resulted in inferior weed control, while at the other, which suffered drought conditions throughout the growing season, all three PRE treatments performed poorly. At one location, yields were similar for all weed control strategies except the untreated plots, where yields were lower. At the other, late rains in September influenced the development of the fungal pathogen, Alternaria pod rot that may have affected harvestable yield.

Potential preharvest options for narrow row dry edible bean desiccation
Christy Sprague

Even dry down of dry edible beans is important for direct cut harvest operations. These harvest operations often favor planting dry beans in narrow row widths. Growers often need to apply a preharvest herbicide application help aid in desiccation of dry edible beans. Currently, there are four herbicide options labeled for preharvest application in dry edible beans. The current options aren't always 100% effective and there are potential issues with herbicide residues found in the harvested crop if applications are not made at the appropriate time. In late-summer of 2010, 17 potential preharvest treatments were evaluated for the speed and effectiveness of desiccation of dry beans planted in narrow rows. These treatments included the current standards of Gramoxone and glyphosate (Roundup) and also newer registered compounds of Aim and Valor. The treatments also included various tank-mixtures of registered products and three non-labeled potential products. One of the newer products Sharpen (saflufenacil) provided the quickest most complete control. The other two products were natural products that did not dry down any different than the non-treated control. We will be working with the manufacturer of Sharpen for registration, potentially offering Michigan dry bean producers a more effective, potentially safer dry bean desiccation option.

Dissemination of Results (Year 1):

Presentation of results to Michigan growers and agri-business representatives:

Saginaw Valley Research and Extension Center Field Day. August 24, 2010. Richville, MI. –Holmes, Powell, and Sprague.

Results from the first year of this research will be presented at several county dry bean meetings in the winter of 2011.

Presentation of results at Scientific Meetings:

Holmes, R.C. and C.L. Sprague. 2010. Weed control strategies and row width in an upright variety of black bean. Proc. North Cent. Weed Sci. Soc. 65:103.

Scheduled Scientific Presentations for FY11:

One presentation is scheduled at the 2011 Weed Science Society of America annual meeting in February in Portland, OR and the North Central Weed Science Society in December 2011.

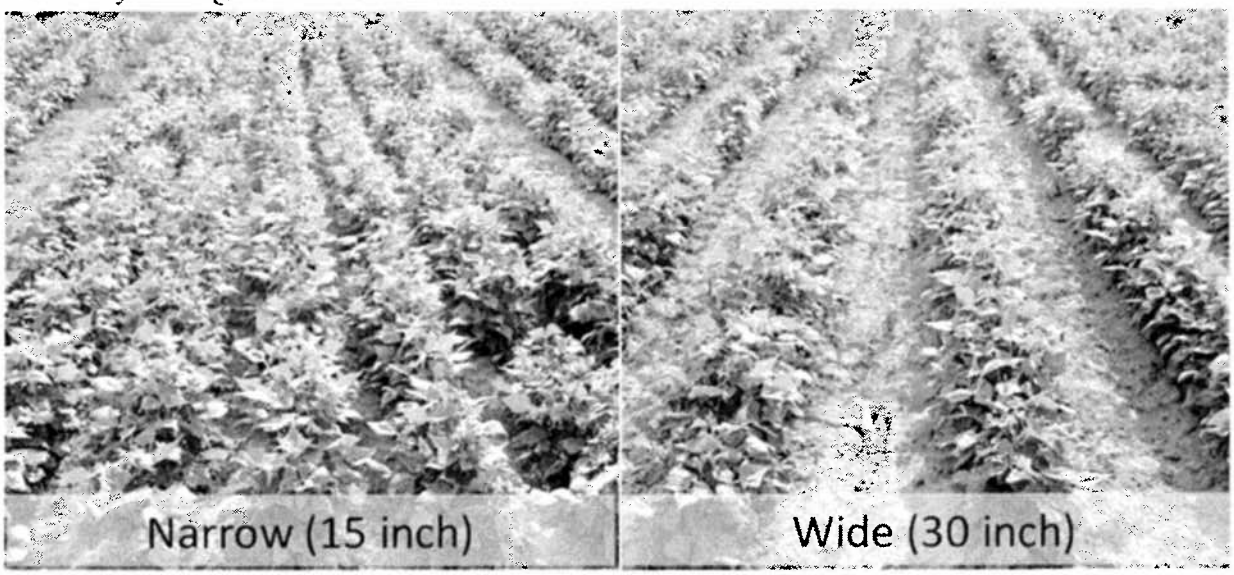
Projected Activities: Conduct the second year of field research and finish analysis on canopy closure and economic impact data. Continue to disseminate results at grower meetings, field days and scientific conferences. Publish research in peer-reviewed scientific journals.

Impacts:

- Development of recommendations for Michigan growers with the benefits and limitations of narrow row dry bean production
- Reduction in soil erosion and compaction by eliminating the use of inter-row cultivation for weed control
- Improved sustainability and profitability of dry bean production in Michigan

Funding Partners: Michigan Department of Agriculture's Specialty Crops Program through the funded Michigan Dry Bean Industry's proposal titled *Assessment of "Narrow Row Technology" for the Michigan Dry Bean Industry* ($10,000 to Sprague).

Figure 1. Weeds were suppressed in dry bean grown in narrow row (15-inch) more than dry bean grown in wide-rows.



Effect of row width, population, and herbicide treatment on dry bean yield (Saginaw Valley Research and Extension Center – 2010)

Christy Sprague, Ryan Holmes, and Gary Powell, Michigan State University

Location:	Richville (SVREC)	**Tillage:**	Conventional
Planting Date:	June 10, 2010	**Herbicides:**	see treatments
Soil Type:	Clay	**Replicated:**	4 times

Table 1. The main-effects of row-width and herbicide treatment affected black bean yield. Black bean population did not significantly affect yield.

'ZORRO' BLACK BEANS					
ROW-WIDTH EFFECT		**POPULATION EFFECT**		**HERBICIDE EFFECT**	
	— cwt/A —	— seeds/A —	— cwt/A —		— cwt/A —
15-inch	14.3 B[b]	**79,500**	15.0	**Weed-free**	14.4 B
20-inch	14.9 AB	**106,000**	14.8	**POST**[a]	15.8 A
30-inch	16.0 A	**132,500**	15.5		
$LSD_{0.05}$	1.4		N.S.		1.14

[a] Raptor (4 fl oz) + Basagran (8 fl oz) + COC (1%) + AMS (2.5 lb) applied to 2-4" weeds.

[b] Means in each column followed by the same letter are not significantly different at $P \leq 0.05$, N.S. = not significant.

Table 2. Small red bean yield was affected by row-width, population, and herbicide treatment.

'MERLOT' SMALL RED BEANS						
	WEED-FREE			POST[a]		
Population	**15-inch**	**20-inch**	**30-inch**	**15-inch**	**20-inch**	**30-inch**
	cwt/A			cwt/A		
60,000	15.3 ABC	15.1 ABC	15.3 ABC	15.8 ABC	14.5 ABC	14.3 BCD
79,500	17.2 A	13.7 CD	16.7 AB	16.3 ABC	16.0 ABC	14.9 ABC
106,000	13.9 BCD	15.6 ABC	13.8 BCD	14.5 ABC	11.8 D	14.9 ABC
$LSD_{0.05}$			2.9			

[a] Raptor (4 fl oz) + Basagran (8 fl oz) + COC (1%) + AMS (2.5 lb) applied to 2-4" weeds.
[b] Means followed by the same letter are not significantly different at P≤0.05.

Summary: This trial was conducted to determine the effect of row width and population on yield of two classes of dry bean. This trial was conducted at two different locations, this location the Saginaw Valley location suffered from drought, resulting in average yields of 15 cwt/A for both black and small red beans. Black bean population did not have a significant affect yield; however row width had a major impact (Table 1). The main effect of row width indicated that black beans planted in wide rows (30 inches) benefited under drought conditions compared with black beans planted in 15 inch rows. However, yield of black beans planted in 20 inch rows were not different from black bean planted in 30 or 15 inch rows. There was a three-way interaction for yield of the small red beans (Table 2). With small red beans, yield was generally higher either at lower populations or narrower row-widths. Due to lower weed populations at this location we did not observe any differences in weed suppression for any of the treatments. Black and small red beans reacted differently to row-width and population under these drought conditions. This research was funded by Project GREEEN and the Michigan Dry Bean Commission grant from the Michigan Department of Agriculture Specialty Crops.

Effect of row width, population, and herbicide treatment on dry bean yield
(MSU Agronomy Farm East Lansing – 2010)

Christy Sprague, Ryan Holmes, and Gary Powell, Michigan State University

Location:	East Lansing	**Tillage:**	Conventional
Planting Date:	June 16, 2010	**Herbicides:**	see treatments
Soil Type:	Loam	**Replicated:**	4 times

Table 1. Black bean yields are combined over herbicide treatments. At P≤0.01 row-width and population affected yield. Black beans planted in narrow rows had higher yields.

'ZORRO' BLACK BEANS			
Population	**15-inch**	**30-inch**	**MAIN ROW-WIDTH**

			EFFECT	
	cwt/A			
79,500	27.1 ABC[a]	26.7 BC	**15-inch**	29.0 A
106,000	30.4 A	25.5 CD	**30-inch**	24.8 B
132,500	29.5 AB	22.2 D	$LSD_{0.05}$	2.6
$LSD_{0.1}$	3.7			

[a] Means followed by the same letter are not significantly different.

Table 2. There were no differences in small red bean yield, regardless of row-width or population.

'MERLOT' SMALL RED BEANS		
Population	**15-inch**	**30-inch**
	cwt/A	
60,000	21.1	22.1
79,500	22.8	22.7
106,000	24.3	21.6
$LSD_{0.05}$	N.S.[a]	

[a] N.S. = not significant.

Summary: This trial was conducted to determine the effect of row width and population on yield of two classes of dry bean. This trial was conducted at two different locations. At this location, East Lansing, moisture was not as limiting as the Richville location. Yield was favored for dry beans planted in narrow rows. Average black bean yield for this trial were 27 cwt/A. The main effect of row width showed a 4.2 cwt/A advantage for black beans planted in 15 inch rows over black beans planted in 30 inch rows (Table 1). The row width by population interaction was significant at (P = 0.0916), favoring black bean planted in narrow rows at the mid-population. For small red beans, regardless of row width or bean population the average yield was 22 cwt/A (Table 2). Indicating the 'Merlot' small red beans may have the ability to compensate for space regardless of population or row width. White mold did not develop in this trial and there did not appear to be a row width or population effect on the low level of western bean cutworm found. One thing we observed was the ability of narrower row widths to suppress weed growth in our POST only treatments in these trials. We also observed that the small red beans significantly reduced weed growth compared with the black beans. Under these environmental conditions there was a clear yield and weed suppression benefit to planting black beans in narrow rows. This research was funded by Project GREEEN and the Michigan Dry Bean Commission grant from the Michigan Department of Agriculture Specialty Crops.